NOTES ON THE THEORY, METHOD OF FIELD OPERATION
AND PRESENTATION OF DATA
FOR THE INDUCED POLARIZATION METHOD
Induced Polarization as a geophysical measurement refers to the blocking action or polarization of metallic or electronic conductors in a medium of ionic solution conduction.

This electro-chemical phenomenon occurs wherever electrical current is passed through an area which contains metallic minerals such as base metal sulphides. Normally, when current is passed through the ground, as in resistivity measurements, all of the conduction takes place through ions present in the water content of the rock, or soil, i.e. by ionic conduction. This is because almost all minerals have a much higher specific resistivity than ground water. The group of minerals commonly described as "metallic", however, have specific resistivities much lower than ground waters. The induced polarization effect takes place at those interfaces where the mode of conduction changes from ionic in the solutions filling the interstices of the rock to electronic in the metallic minerals present.
in the rock.

The blocking action or induced polarization mentioned above, which depends upon the chemical energies necessary to allow the ions to give up or receive electrons from the metallic surface, increases with the time that a d.c. current is allowed to flow through the rock; i.e. as ions pile up against the metallic interface the resistance to current flow increases. Eventually, there is enough polarization in the form of excess ions at the interfaces, to appreciably reduce the amount of current flow through the metallic particle. This polarization takes place at each of the infinite number of solution-metal interfaces in a mineralized rock.

When the d.c. voltage used to create this d.c. current flow is cut off, the Coulomb forces between the charged ions forming the polarization cause them to return to their normal position. This movement of charge creates a small current flow which can be measured on the surface of the ground as a decaying potential difference.

From an alternate viewpoint it can be seen that if the direction of the current through the system is reversed repeatedly before the polarization occurs, the effective resistivity of the system as a whole will change as the frequency of the switching is changed. This is a consequence of the fact that the amount of current flowing through each metallic interface depends upon the length of time that current has been passing through it in one direction.
The values of the per cent frequency effect or F.E. are a measurement of the polarization in the rock mass. However, since the measurement of the degree of polarization is related to the apparent resistivity of the rock mass it is found that the metal factor values or M.F. are the most useful values in determining the amount of polarization present in the rock mass. The MF values are obtained by normalizing the F.E. values for varying resistivities.

The induced polarization measurement is perhaps the most powerful geophysical method for the direct detection of metallic sulphide mineralization, even when this mineralization is of very low concentration. The lower limit of volume per cent sulphide necessary to produce a recognizable IP anomaly will vary with the geometry and geologic environment of the source, and the method of executing the survey. However, sulphide mineralization of less than one per cent by volume has been detected by the IP method under proper geological conditions.

The greatest application of the IP method has been in the search for disseminated metallic sulphides of less than 20% by volume. However, it has also been used successfully in the search for massive sulphides in situations where, due to source geometry, depth of source, or low resistivity of surface layer, the EM method can not be successfully applied. The ability to differentiate ionic conductors, such as water filled shear zones, makes the IP method a useful tool in checking EM
anomalies which are suspected of being due to these causes.

In normal field applications the IP method does not differentiate between the economically important metallic minerals such as chalcopyrite, chalcocite, molybdenite, galena, etc., and the other metallic minerals such as pyrite. The induced polarization effect is due to the total of all electronic conducting minerals in the rock mass. Other electronic conducting materials which can produce an IP response are magnetite, pyrolusite, graphite, and some forms of hematite.

In the field procedure, measurements on the surface are made in a way that allows the effects of lateral changes in the properties of the ground to be separated from the effects of vertical changes in the properties. Current is applied to the ground at two points in distance (X) apart. The potentials are measured at two other points (X) feet apart, in line with the current electrodes is an integer number (n) times the basic distance (X).

The measurements are made along a surveyed line, with a constant distance (nX) between the nearest current and potential electrodes. In most surveys, several traverses are made with various values of (n); i.e. (n) = 1, 2, 3, 4, etc. The kind of survey required (detailed or reconnaissance) decides the number of values of (n) used.

In plotting the results, the values of the apparent resistivity, apparent per cent frequency effect, and the apparent metal factor...
measured for each set of electrode positions are plotted at the intersection of grid lines, one from the center point of the current electrodes and the other from the center point of the potential electrodes. (See Figure A.) The resistivity values are plotted above the line as a mirror image of the metal factor values below. On a second line, below the metal factor values, are plotted the values of the per cent frequency effect. In some cases the values of per cent frequency effect are plotted as superscripts of the metal factor value. In this second case the frequency effect values are not contoured. The lateral displacement of a given value is determined by the location along the survey line of the center point between the current and potential electrodes. The distance of the value from the line is determined by the distance \((nX)\) between the current and potential electrodes when the measurement was made.

The separation between sender and receiver electrodes is only one factor which determines the depth to which the ground is being sampled in any particular measurement. The plots then, when contoured, are not section maps of the electrical properties of the ground under the survey line. The interpretation of the results from any given survey must be carried out using the combined experience gained from field results, model study results and theoretical investigations. The position of the electrodes when anomalous values are measured is important in the interpretation.
In the field procedure, the interval over which the potential differences are measured is the same as the interval over which the electrodes are moved after a series of potential readings has been made. One of the advantages of the induced polarization method is that the same equipment can be used for both detailed and reconnaissance surveys merely by changing the distance \( X \) over which the electrodes are moved each time. In the past, intervals have been used ranging from 25 feet to 2000 feet for \( X \). In each case, the decision as to the distance \( X \) and the values of \( n \) to be used is largely determined by the expected size of the mineral deposit being sought, the size of the expected anomaly and the speed with which it is desired to progress.

The diagram in Figure A demonstrates the method used in plotting the results. Each value of the apparent resistivity, apparent metal factor, and apparent per cent frequency effect is plotted and identified by the position of the four electrodes when the measurement was made. It can be seen that the values measured for the larger values of \( n \) are plotted farther from the line indicating that the thickness of the layer of the earth that is being tested is greater than for the smaller values of \( n \); i.e., the depth of the measurement is increased. When the F.E. values are plotted as superscripts to the MF values the third section of data values is not presented and the F.E. values are not contoured.
The actual data plots included with the report are prepared utilizing an IBM 360/75 Computer and a Calcomp 770/763 Incremental Plotting System. The data values are calculated, plotted, and contoured according to a programme developed by McPhar Geophysics. Certain symbols have been incorporated into the programme to explain various situations in recording the data in the field.

The IP measurement is basically obtained by measuring the difference in potential or voltage \( \Delta V \) obtained at two operating frequencies. The voltage is the product of the current through the ground and the apparent resistivity of the ground. Therefore in field situations where the current is very low due to poor electrode contact, or the apparent resistivity is very low, or a combination of the two effects; the value of \( \Delta V \) the change in potential will be too small to be measurable. The symbol "TL" on the data plots indicates this situation.

In some situations spurious noise, either man made or natural, will render it impossible to obtain a reading. The symbol "N" on the data plots indicates a station at which it is too noisy to record a reading. If a reading can be obtained, but for reasons of noise there is some doubt as to its accuracy, the reading is bracketed in the data plot ( ).

In certain situations negative values of Apparent Frequency Effect are recorded. This may be due to the geologic environment or spurious electrical effects. The actual negative frequency effect value recorded is indicated on the data plot, however the symbol "NEG" is
indicated for the corresponding value of Apparent Metal Factor. In contouring negative values the contour lines are indicated to the nearest positive value in the immediate vicinity of the negative value.

The symbol "NR" indicates that for some reason the operator did not attempt to record a reading although normal survey procedures would suggest that one was required. This may be due to inaccessible topography or other similar reasons. Any symbol other than those discussed above is unique to a particular situation and is described within the body of the report.
METHOD USED IN PLOTTING DIPOLE-DIPOLE
INDUCED POLARIZATION AND RESISTIVITY RESULTS

Stations on line

\[ x = \text{Electrode spread length} \]
\[ n = \text{Electrode separation} \]

\[ n - 4 \]
\[ \rho \]
\[ 1.2 - 6.7 \]
\[ 2.3 - 7.8 \]
\[ 3.4 - 8.9 \]
\[ \rho \]
\[ n - 3 \]
\[ \rho \]
\[ 1.2 - 5.6 \]
\[ 2.3 - 6.7 \]
\[ 3.4 - 7.8 \]
\[ 4.5 - 8.9 \]
\[ \rho \]
\[ n - 2 \]
\[ \rho \]
\[ 1.2 - 4.5 \]
\[ 2.3 - 5.6 \]
\[ 3.4 - 6.7 \]
\[ 4.5 - 7.8 \]
\[ 5.6 - 8.9 \]
\[ \rho \]
\[ n - 1 \]
\[ \rho \]
\[ 1.2 - 3.4 \]
\[ 2.3 - 4.5 \]
\[ 3.4 - 5.6 \]
\[ 4.5 - 6.7 \]
\[ 5.6 - 7.8 \]
\[ 6.7 - 8.9 \]
\[ \rho \]
\[ n - 1 \]
\[ \rho \]
\[ 1.2 - 3.4 \]
\[ 2.3 - 4.5 \]
\[ 3.4 - 5.6 \]
\[ 4.5 - 6.7 \]
\[ 5.6 - 7.8 \]
\[ 6.7 - 8.9 \]
\[ M.F. \]
\[ n - 2 \]
\[ M.F. \]
\[ 1.2 - 4.5 \]
\[ 2.3 - 5.6 \]
\[ 3.4 - 6.7 \]
\[ 4.5 - 7.8 \]
\[ 5.6 - 8.9 \]
\[ M.F. \]
\[ n - 3 \]
\[ M.F. \]
\[ 1.2 - 5.6 \]
\[ 2.3 - 6.7 \]
\[ 3.4 - 7.8 \]
\[ 4.5 - 8.9 \]
\[ M.F. \]
\[ n - 4 \]
\[ M.F. \]
\[ 1.2 - 6.7 \]
\[ 2.3 - 7.8 \]
\[ 3.4 - 8.9 \]

\[ n - 1 \]
\[ \rho \]
\[ 1.2 - 3.4 \]
\[ 2.3 - 4.5 \]
\[ 3.4 - 5.6 \]
\[ 4.5 - 6.7 \]
\[ 5.6 - 7.8 \]
\[ 6.7 - 8.9 \]
\[ F.E. \]
\[ n - 2 \]
\[ F.E. \]
\[ 1.2 - 4.5 \]
\[ 2.3 - 5.6 \]
\[ 3.4 - 6.7 \]
\[ 4.5 - 7.8 \]
\[ 5.6 - 8.9 \]
\[ F.E. \]
\[ n - 3 \]
\[ F.E. \]
\[ 1.2 - 5.6 \]
\[ 2.3 - 6.7 \]
\[ 3.4 - 7.8 \]
\[ 4.5 - 8.9 \]
\[ F.E. \]
\[ n - 4 \]
\[ F.E. \]
\[ 1.2 - 6.7 \]
\[ 2.3 - 7.8 \]
\[ 3.4 - 8.9 \]

\[ n - 1 \]
\[ M.F. \]
\[ n - 2 \]
\[ M.F. \]
\[ n - 3 \]
\[ M.F. \]
\[ n - 4 \]
\[ M.F. \]

\[ n - 1 \]
\[ M.F. \]
\[ n - 2 \]
\[ M.F. \]
\[ n - 3 \]
\[ M.F. \]
\[ n - 4 \]
\[ M.F. \]

\[ \text{Apparent Metal Factor} \]

\[ n - 1 \]
\[ F.E. \]
\[ n - 2 \]
\[ F.E. \]
\[ n - 3 \]
\[ F.E. \]
\[ n - 4 \]
\[ F.E. \]

\[ \text{Apparent Percent Frequency Effect} \]

\[ \text{Fig. A} \]
REPORT ON THE
INDUCED POLARIZATION
AND
RESISTIVITY SURVEY
AT THE OLD FORT CLAIMS
BABINE LAKE, B.C.

Vancouver, B.C.
July 30, 1971

D. B. Sutherland
P. Eng. (Ont.)

S. E. Sapper
B. Sc., D.I.C.

D. H. Brown
P. Eng. (B.C.)
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<td>Foll. Appendix C</td>
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<td>Following page 1</td>
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<td>Figure 4 - Line 2 S Dipole-Dipole I.P. Data</td>
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<td>Figure 5 - Line 6 N Dipole-Dipole I.P. Data</td>
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REPORT ON THE
INDUCED POLARIZATION
AND
RESISTIVITY SURVEY
AT THE OLD FORT CLAIMS
BABINE LAKE, B. C.

1. INTRODUCTION

The survey was carried out using Falconbridge's crew of two operators, M. and J. Menard, with the assistance of two helpers, J. Fallon and L. McLeod, during the period of June 10 to June 24, 1971.

The survey area is situated in the Babine Lake district, northwest of the Newman and Granisle copper deposits (55°08'00"N, 126°22'00"E - see Figure 1). The property lies approximately 40 miles northeast of Smithers, B. C.

Most of the Babine Lake district is mantled by glacial till and glacio-fluvial material. Isolated hills and highlands or more resistant rocks occur in the lower areas. Geologic work is continually frustrated by the lack of suitable rock exposure. However, the property is underlain principally by volcanic and sedimentary rocks tentatively included here with the Jurassic and Cretaceous Hazelton group.

These rocks are altered to hornfels in a belt extending westward towards the summit of Old Fort Mountain. A small quartz-diorite stock outcrops on the eastern flank of the hornfels and contains the chief zones of mineralization. Dykes of granitic rock occur throughout the area.

The induced polarization and resistivity survey was carried out to try to outline the sources of mineralization which has been located in outcrops on the eastern flank of the hornfels.
FIGURE 1

FALCONBRIDGE NICKEL MINES LTD.
OLD FORT PROPERTY

Scale 1" = 4 miles
A McPhar P660 variable frequency unit operating at 0.3 and 5.0 Hz was used. The lines were covered with Dipole-Dipole 300' intervals to N=3.

2. PRESENTATION OF RESULTS

The induced polarization and resistivity results are shown on the following data plots in the manner described in the notes preceding this report.

<table>
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<th>Line</th>
<th>Electrode Intervals</th>
<th>Drawing No.</th>
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<tr>
<td>10 S</td>
<td>300 feet</td>
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<td>I.P. 2</td>
</tr>
<tr>
<td>6 N</td>
<td>300 feet</td>
<td>I.P. 3</td>
</tr>
<tr>
<td>14 N</td>
<td>300 feet</td>
<td>I.P. 4</td>
</tr>
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</table>

Enclosed with this report is Drawing I.P. 5, a plan map of the Old Fort grid at a scale of 1''=500'. The definite, probable and possible induced polarization anomalies are indicated by solid and broken bars respectively on this plan map as well as the data plots. These bars represent the surface projection of the anomalous zones as interpreted from the location of the transmitter and receiver electrodes when the anomalous values were measured.

Since the induced polarization measurements are essentially an averaging process as are all potential methods, it is frequently difficult to exactly pinpoint the source of the anomaly. Certainly, no anomaly can be located with more accuracy than the spread length; i.e. when using 300' spread, the position of a narrow sulphide body can only be determined to lie between two stations 300' apart in order to locate sources in the uncertainties of location. Therefore, while the center of the indicated anomaly probably corresponds fairly well with source, the length of the indicated anomaly along the line should not be taken to represent the exact edges of
the anomalous materials.

3. DISCUSSION OF RESULTS

Four lines running east-west each of about 7000' long were surveyed.

Line 10 S

This line was surveyed with 300' electrode intervals and to N=3. The results show that the background is fairly anomalous over the whole length of the surveyed line and a wide, shallow, definite anomaly was located between 49E and the west end of the line. The anomaly is not completed and the survey should be extended easily beyond 25E. However, the best and strongest portion of this anomaly is located between 49E and 38E where the anomaly appears to improve with depth.

Line 2 S

This line was also surveyed with 300' dipole intervals and to N=3. The results show that the background over the surveyed length is fairly anomalous.

Two wide, shallow, definite anomalies were located on this line. The first was between 37E and 43E with its strongest portion between 40E and 43E. The second anomaly was located between 49E and 53E with its best portion between 52E and 53E.

Two other narrow, deep, moderate anomalies were located on this line. The first anomaly was located in the vicinity of 31E and the second anomaly was in the vicinity of 67E. Both appears to improve with depth.

The above anomalies are of low resistivity relatively high frequency effect, and consequently high metal factor.

Line 6 N

The line was surveyed with 300' dipole intervals and to N=3. The
background appears to be fairly anomalous and the results show a wide, shallow, strong anomaly located between 40E and 75E and possibly further since the anomaly is not completed on the east end of the line.

The anomaly appears to be due to a number of closely-spaced sources. Therefore, it should be detailed with shorter electrodes to obtain better definition. However, as it stands now, the best portions of this anomaly are those located between 49E and 61E and 71E to the east end of the line.

Another possible anomaly is located between 22E and 13E. Here, the anomaly might be due to two narrow closely-spaced sources. Therefore, the anomaly should be detailed with shorter electrode intervals to better resolve the individual sources.

Line 14 N

The results show a fairly anomalous background over the whole length of the surveyed line. However, a strong, definite anomaly is located between 51E and 60E, with its best portion in the vicinity of 54E and 58E. The anomaly is wide, shallow and it might be caused by strong, narrow closely-spaced sources between 45E and 48E, 36E and 39E, 75E and the east end of the line. The last anomaly may be definite if the survey is extended to the east. The first two possible anomalies are shallow and probably due to narrow sources. However, all the anomalies located on this line should be detailed with shorter electrode intervals.

4. SUMMARY AND RECOMMENDATIONS

The frequency effects are above average on the whole length of the surveyed lines and the resistivities are below; suggesting weakly disseminated mineralization throughout the area.

The strong and most definite anomalies located throughout the area
appears to fall in a broad but definite zone which probably trends north-south. It is very difficult at this stage of the survey to outline the exact trend of the located zone because the anomaly is wide open to the east. It appears that this wide zone consists of a number of narrower closely-spaced zones.

It is suggested, therefore, to extend the grid both north-south. In addition, intermediate lines should be surveyed to trace the sub-zones, and shorter electrode intervals should be used to better define the sources and their trends. It is also suggested that vertical loop or horizontal E. M. survey be used to indicate the conductor and its characteristics more accurately, (i.e. their axis, dip, width and depth, and position) in addition to the apparent conductivity.

D. B. Sutherland,
B.A., M.A., P.Eng.(Ont.)

S. E. Sapper,
B.Sc., D.I.C.

Vancouver, B. C.
July 30, 1971

D. H. Brown,
B.A.Sc., P.Eng.(B.C.)
DOMINION OF CANADA:

PROVINCE OF BRITISH COLUMBIA

To Wit:

In the Matter of the Geophysical survey on DDT, OFF, and RAID Mineral Claims.

1. David H. Brown

of 504 - 1112 W. Pender St., Vancouver 1, B. C.

in the Province of British Columbia, do solemnly declare that the following work was done:

Assessment Credit Data

Miles surveyed 5.5
No. of readings 250

Personnel

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<th>Name</th>
<th>Position</th>
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<th>Rate/day</th>
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<td>J. Menard</td>
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<tr>
<td>S. E. Sapper</td>
<td>Sr. Geophysicist</td>
<td>July 13-14</td>
<td>1½</td>
<td>100</td>
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$2,640.00

Geophysical assistants, J. Fallon and L. McLeod are accounted for separately by Falconbridge Nickel Mines Limited, Vancouver Office.

And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of the "Canada Evidence Act."

Declared before me at the City of Vancouver, in the Province of British Columbia, this 3 day of August, 1971, A.D.

[Signature]

A Commissioner for taking Affidavits within British Columbia or A Notary Public in and for the Province of British Columbia.

Bob — mining Recorder
July 30, 1971

The Chief Mining Recorder
Omineca Mining Division
Smithers, B. C.

Dear Sir:

Re: Statement of Qualifications

This is to certify that the geophysical work done on the RAID, OFF, and DDT Mineral Claims and presented in this report was done under the direction of D. B. Sutherland, B.A., M.A. (University of Toronto) and under my supervision.

The geophysical field work was performed by M. Menard, Party Chief, and J. Menard, Geophysical Operator and were assisted by J. Fallon and L. McLeod. M. Menard has been trained in the laboratory and in the field as a geophysical party chief and operator. J. Menard has been trained in the field as a geophysical operator. J. Fallon and L. McLeod have been trained in the field as geophysical assistants.

S. E. Sapper, B. Sc. (University of Bagdad) and D.I.C. (Imperial College, University of London, England) is a qualified geophysicist with nine years' experience in all relevant geophysical techniques.

I am a graduate in engineering geology from the University of British Columbia and a member of the Association of Professional Engineers of Ontario and British Columbia.

Yours very truly,

FALCONBRIDGE NICKEL MINES LIMITED


DHB:1st
APPENDIX C

THE INTERPRETATION OF
INDUCED POLARIZATION ANOMALIES
FROM RELATIVELY SMALL SOURCES

The induced polarization method was originally developed to detect disseminated sulphides and has proven to be very successful in the search for "porphyry copper" deposits. In recent years we have found that the IP method can also be very useful in exploring for more concentrated deposits of limited size. This type of source gives sharp IP anomalies that are often difficult to interpret.

The anomalous patterns that develop on the contoured data plots will depend on the size, depth and position of the source and the relative size of the electrode interval. The data plots are not sections showing the electrical parameters of the ground. When the electrode interval (X) is appreciably greater than the width of the source, a large volume of unmineralized rock is averaged into each measurement. This is particularly true for the large values of the electrode separation (n).

The theoretical scale model results shown in Figure 1 and Figure 2 indicate the effect of depth. If the depth to the top of the source is small compared to the electrode interval (i.e. d X) the measurement for n = 1 will be anomalous. In Figure 1 the depth is 0.5 units (X = 1.0 units) and the n = 1 value is definitely anomalous; the pattern on the contoured data plot is typical for a relatively shallow, narrow, near-vertical tabular source. The results in Figure 2 are for the same source with the depth increased to 1.5 units. Here the n = 1 value is not anomalous; the larger values of (n) are anomalous but the magnitudes are much lower than for the source at less depth.

When the electrode interval is greater than the width of the source, it is not possible to determine its width or exact position between the electrodes. The true IP effect within the source is also indeterminate; the anomaly from a very narrow source with a very large true IP effect will be much the same as that from a zone with twice the width and 1/2 the true IP effect. The theoretical scale model data shown in Figure 3 and Figure 4 demonstrate this problem. The depth and position of the source are unchanged but the width and true IP effect are varied. The anomalous patterns and magnitudes are essentially the same, hence the data are insufficient to evaluate the source completely.

The normal practise is to indicate the IP anomalies by solid, broken, or dashed bars, depending upon their degree of distinctiveness. These bars represent the surface projection of the anomalous zones as interpreted from the location of the transmitter and receiver electrodes.
when the anomalous values were measured. As illustrated in Figure 1, Figure 2, Figure 3 and Figure 4, no anomaly can be located with more accuracy than the spread length. While the centre of the solid bar indicating the anomaly corresponds fairly well with the source, the length of the bar should not be taken to represent the exact edges of the anomalous material.

If the source is shallow, the anomaly can be better evaluated using a shorter electrode interval. When the electrode interval used approaches the width of the source, the apparent effects measured will be nearly equal to the true effects within the source. When there is some depth to the top of the source, it is not possible to use electrode intervals that are much less than the depth to the source. In this situation, one must realize that a definite ambiguity exists regarding the width of the source and the IP effect within the source.

Our experience has confirmed the desirability of doing detail. When a reconnaissance IP survey using a relatively large electrode interval indicates the presence of a narrow, shallow source, detail with shorter electrode intervals is necessary in order to better locate, and evaluate, the source. The data of most usefulness is obtained when the maximum apparent IP effect is measured for \( n = 2 \) or \( n = 3 \). For instance, an anomaly originally located using \( X = 300' \) may be checked with \( X = 200' \) and then \( X = 100' \). The data with \( X = 100' \) will be quite different from the original reconnaissance results with \( X = 300' \).

The data shown in Figure 5 and Figure 6 are field results from a greenstone area in Quebec. The expected sources were narrow (less than 30' in width) zones of massive, high-grade, zinc-silver ore. An electrode interval of 200' was used for the reconnaissance survey in order to keep the rate of progress at an acceptable level. The anomalies located were low in magnitude.

The very weak, shallow anomaly shown in Figure 5 is typical of those located by the \( X = 200' \) reconnaissance survey. Several anomalies of this type were detailed using shorter electrode intervals. In most cases the detail measurements suggested broad zones of very weak mineralization. However, in the case of the source at 20N to 22N, the measurements with shorter electrode intervals confirmed the presence of a strong, narrow source. The \( X = 50' \) results are shown in Figure 6. Subsequent drilling has shown the source to be 12.5' of massive sulphide mineralization containing significant zinc and silver values.

The change in the anomaly that results when the electrode interval is reduced is not unusual. The \( X = 50' \) data more accurately locates the narrow source, and permits the geophysicist to make a better evaluation of its importance. The completion of this type of detail is very important, in order to get the maximum usefulness from a reconnaissance IP survey.
Theoretical Induced Polarization and Resistivity Studies
Scale Model Cases

\[(P/2\pi)_{a}\]

\[(fe)_{a}\]

\[(Mf)_{a}\]

\[(P/2\pi)_{1} = 10\]
\[(Mf)_{1} = 0\]
\[(fe)_{2} = 25\%\]

CASE II-05-BU-10-a

FIG 1

\[(P/2\pi)_{2} = 2.51\]
\[(Mf)_{2} = 10000\]

CASE II-15-BU-10-a

FIG 2
INDUCED POLARIZATION AND RESISTIVITY RESULTS
BATCHelor LAKE AREA, QUEBEC.

**FIG. 5**

**FIG. 6**

**MASSIVE SULPHIDE ZONE**
APPENDIX D

EXPECTED IP ANOMALIES FROM "PORPHYRY COPPER" TYPE ZONES OF DISSEMINATED SULPHIDE MINERALIZATION

Our experience in other areas has shown that the induced polarization method can be successfully used to locate, and outline, zones of disseminated sulphide mineralization of the "porphyry copper" type. In most cases the interpretation of the IP results is simple and straightforward. The results shown in Figure 1 and Figure 2 are typical.

![Diagram of Induced Polarization and Drilling Results from Copper Mountain Area, Gaspe, Quebec](image)
The source of the moderate magnitude IP anomaly shown in Figure 1 contains approximately 4% metallic mineralization. The zone is of limited lateral extent and enough copper is present to make the mineralization "ore grade". The presence of the surface oxidation can be seen in the fact that the apparent IP effects increase for $n = 2$.

The IP anomaly shown in Figure 2 has about the same magnitude as that described above. It should be noted that appreciably greater concentrations of metallic mineralization are present; further, there is little or no copper present. These results illustrate the fact that IP results can not be used to determine the exact amount of metallic mineralization present or to determine the economic importance of a mineralized zone. In some geologic situations zoning is present; the zones of mineralization of greatest economic value may contain less total metallic mineralization than other zones in the same general area.
In the proper geologic environment, the method will detect even very low concentrations of metallic mineralization. The IP results shown in Figure 3 located the ore zone at the Brenda Property near Peachland, B.C. The zone contains 1.0 to 1.5 per cent metallic mineralization; however, the mineralization is "ore grade" because only molybdenite and chalcopyrite are present.

**INDUCED POLARIZATION AND DRILLING RESULTS FROM BRENTA AREA PEACHLAND, B.C.**

**LINE-8S**

FREQUENCIES 0-318, 50 CPS.

\[ X = \text{400 FEET} \]